

Remarks

Claims 1-10 are pending in the application. Claims 1-10 are rejected. Claim 10 is amended to claim multiple dependencies in the alternative. The amendment corrects a clerical error only. The rejections are respectfully traversed.

Claim 1 is rejected under 35 USC 102(a) as being anticipated by Hoff, et al., "Fast and simple 2D geometric proximity queries using graphics hardware," (Hoff).

Hoff only computes proximity information for two or more objects. In other words, Hoff calculates distances between objects so that it can be determined whether objects are about to collide, intersect, separate, or penetrate. The two or more objects themselves **never** change.

The input to the Hoff method is a **geometry** or shape of each object in the form of *polygons*. First, Hoff finds a bounding rectangular region that contains the portions of the objects that are closest to each other, **not** the whole object. The rectangular region is **uniformly** sampled using polygon rasterization hardware. The hardware used is a pixel frame buffer. The sampling determines a *regularly* sampled distance field. The regularly sampled distance field can then be used to determine distances between close object features. Note, in Hoff the distance field **never** represents the object.

Invention
Prior art
no good

The invention combines two or more objects to create a new object. For example, two spherical shapes can be squished together to make a new oblong shaped object. Alternatively, one object is modified according to features of a second object. Therefore, Hoff is inapplicable and not relevant to the invention. Nowhere does Hoffman disclose describe, or show how to combine objects to create new objects. Measuring distances between two objects can never anticipate combining the two objects. Furthermore, because the Hoff distance fields are only generated for close or contact features of objects, they can never be used to create a new object.

The inputs to the invention are distance fields representing entire objects. In contrast, the inputs to Hoff are geometric (polygon) representations of the objects. Those of ordinary skill in the art would never confuse a geometric model with a distance field model. Furthermore, according to the present invention, the distance field represents the entire object, not a region in space where objects are close or intersect as in Hoff.

Furthermore, the distance fields according to the invention are adaptively (irregularly) sampled. The distance field in Hoff **must** and can only be uniformly or regularly sampled, because a pixel frame buffer is used as a grid. Also, please note numerous other references to "uniform" or "grid" sampling in Hoff. Reference [5] at page 145, merely indicates that a distance field can be adaptive. However, Hoff recognizes, and states so, right below,

that adaptive distance fields are not suitable for his method, which uses graphics hardware with an uniformly spaced pixel resolution.

Hoff never samples distance fields, see page 146. Instead, Hoff samples the geometries (polygons) in the region of interest to generate his regular uniformly sampled distance field, see page 146, "We point-sample the geometry and the space around the geometry within the localized regions with a uniform rectangular grid and perform the queries on this volumetric representation using graphics hardware acceleration."

Not a single distance value in Hoff is ever modified or altered in any way. There are two obvious reasons for this. First, Hoff is not interested in creating new objects, and second, modifying his distance values would give erroneous proximity information.

MPEP 2131 explicitly states that in order to anticipate a claim "each and every element as set forth in the claims" must be found in the prior art reference. "The identical invention must be shown in as complete detail as is contained in the ... claim." Hoff cannot anticipate what is claimed. First, Hoff rejects adaptive distance fields, see Hoff, page 145, 2nd paragraph. Further, the entire method described by Hoff is a graphics hardware application. Sampling by Hoff is performed in the pixel frame buffer, so the sampling resolution must be according to a uniform recta-linear grid. This cannot be the adaptive, non-uniform sampling of ADFs.

prior art doesn't touch { Hoff never generates first or second adaptively sampled distance fields for first models or second models as claimed. Hoff generates a regular distance field by uniformly point sampling rectangular regions found by performing coarse geometric localization of space that has either potential intersections or closest feature pairs between objects.

Nowhere does Hoff sample locations in the first adaptively sampled distance field to determine a distance value for each location. Nor does Hoff sample the second adaptively sampled distance field at each location to determine a corresponding feature of the second adaptively sampled distance field for each location. Hoff never samples adaptively sampled distance fields.

Finally, Hoff does not modify distance values. Hoff “computes the proximity information in the localized regions” only, see Hoff, page 146, 2nd paragraph.

What is claimed is modifying each distance value according to the corresponding feature to determine a second distance value for each location. Hoff never modifies distance values as claimed.

Claims 2-7 and 9 are rejected under 35 USC 103(a) as being unpatentable over Hoff, in view of Rockwood et al. (US Patent 5,251,160 – Rockwood).

Rockwood defines primitive surfaces using implicit functions, and then generates blended surface shapes from the implicit functions. First, it should now be obvious that Hoff and Rockwood are incompatible, and deal with different problems. Hoff deals with collision or penetration detection, while

Rockwood blends surfaces. However, Rockwood represents surfaces by implicit function. An implicit function a mathematical way to represent a shape. For example, a sphere is a surface with all points at equal distance (the radius) from the center of the sphere. To determine a surface implicitly, the function is evaluated for a given set of parameters, for example, the radius r . As a characteristic implicit functions are continuous over all values.

In contrast, the invention uses discrete samples. As an advantage, a sampled distance field can be used to represent complex shapes, for example, a face or a head for which it is impossible to formulate an implicit function. As another advantage, a sampled distance field can be obtained from real world objects, by using, for example, a ranging device, or images. Implicit functions are of no use for most real world objects, unless they have a shape that can be mathematically expressed. Rockwood cannot be combined with Hoff, nor can Rockwood be of any use to the sampled distance fields of the invention.

Regarding claim 3, neither Hoff nor Rockwood render any type of adaptively sampled distance field. Hoff renders nothing, and Rockwood could only render implicit functions.

Regarding claim 4, neither Hoff nor Rockwood combine any type of adaptively sampled distance field. Hoff does no combining, Rockwood combines functions.

Regarding claim 5, neither Hoff nor Rockwood combine adaptively sampled distance fields according to a function.

Regarding claim 6, Hoff does not have adaptively sampled distance field models of any dimension.

Regarding claim 7, Hoff is limited to geometric polygon models. Polygon models are totally inappropriate for glyphs, i.e., type faces or characters, letters or numbers.

Regarding claim 9, again Hoff has no adaptively sampled distance representation of object. In addition, the Applicants respectfully request the Examiner to point out with specificity, which word on paragraph 3 on page 145 is believe to be "hyper-dimensional physical model." Applicants cannot find these words, and request that this rejection is withdrawn, unless hyper-dimensional is described by Hoff.

Regarding claim 8, it should be understood that Hoff and Lindbloom are totally unrelated art fields. Applicants are mystified why Hoff, which deals with collision detection, would even be interested in color gamuts. This combination is absurd and unnatural. Furthermore, the color gamut representation in Lindbloom is a 3D table look-up (LUT) obtained from a *continuous* gamut signal encoder. Those of ordinary skill in the art would not confuse a table look-up with any type of distance field. Can the Examiner explain why a collision detection system needs to "produce accurate colors?"

Regarding claim 10, Pfister is unrelated art. Pfister has to do with representing the surface of 3D objects as discrete surface samples ("surfels"). Each surfel has a (x,y,z) location. Because the location of the surfels is precisely known, distance values have no meaning. The applicants request the Examiner to point out which words mean "recursive subdividing cells" in

"As shown in FIG. 2a, surfels 100 (solid) can be located somewhere in cells 200 defined by eight nodes 201 (open) that are integer grid positions. As shown in FIG. 2b, each surfel has six adjacent surfels, one for each cell adjacent to the faces of each cell 200. The grid positions correspond in size and location to pixels 202 of an image plane 203. In other words, the grid that defines the bounds on the locations of the zero-dimensional surfels is defined at the resolution of an image plane or a display screen. Sampling according to the screen resolution provides a direct correspondence between object space and image space. By defining surfels this way, deformation of objects becomes easier in the sense that frequent re-sampling is not needed. Processing "surfelized" objects consumes less time. A surfel grid, with pixel-sized spacing, also provides the possibility to store surfers with offsets, and to use a pre-computed view-transformed offset to efficiently render the surfel objects."

In addition, Pfister also does not disclose the bounded distance tree of claim 10.

All rejections have been complied with, and applicant respectfully submits that the application is now in condition for allowance. The applicant urges the Examiner to contact the applicant's attorney at phone and address indicated below if assistance is required to move the present application to

allowance. Please charge any shortages in fees in connection with this filing to Deposit Account 50-0749.

Respectfully submitted,

By: 

Andrew J. Curtin
Reg. No. 48,485
Attorney for Assignee

Mitsubishi Electric Research Laboratory, Inc.
201 Broadway
Cambridge MA, 02139
(617) 621-7539